Attachment 5

Technical Paper

The specification & design of high availability boilers for the Intermountain Power Project

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Presented to
Pacific Coast Electrical Association, Inc.
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San Francisco, CA
March 18, 1982

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Babcock & Wilcox
a McDermott company

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Background

The Intermountain Consumer Power Association (ICPA) located in Sandy, Utah, was the spearhead organization behind the Intermountain Power Project (IPP). ICPA has members in Utah, Nevada, Wyoming and Arizona. ICPA was granted Single Purchasing Agency status by the Secretary of the Interior in 1964 to purchase Colorado River Storage Power (CRSP) at the major federal points in Utah for delivery to its members.

When informed that additional CRSP power would not be available to meet their anticipated load growth, the ICPA began investigating alternative sources of power including the possibility of developing its own generation, utilizing the abundant Utah coal supplies.

Other utilities within and outside of Utah, including several California utilities, were contacted concerning their interest and participation in the development of a large coal-fired project in Utah.

In early 1974 a feasibility study for the IPP was initiated and, following the completion of this study, the Intermountain Power Agency (IPA) was formed as a means of financing IPP. As a political subdivision of the state of Utah, IPA was enabled to sell bonds for the construction of IPP and in turn sell the power to the project participants. The participants include a combination of 36 municipal and investor-owned utilities within the states of Utah and California.

Project history

When the initial primary site, near Cainsville, Utah, at Salt Wash, Utah, was found to have required an air quality variance, an Interagency Task Force on Power Plant Siting was created by the governor of the state of Utah. Participants included representatives of the federal government, the state of Utah, industrial and environmental interest groups. This task force ultimately proposed two alternative sites that would not require an air quality variance. In March 1978, the alternative site in the vicinity of Lynndyl, in Millard County, Utah was selected and environmental studies were authorized in order to incorporate the Lynndyl site as an alternative in the Environmental Statement.

The final Environmental Statement was filed with the Environmental Protection Agency (EPA) and on December 19, 1979, federal approval of the Lynndyl site was given, including the issuance of the necessary right-of-way grants for project facilities on lands under the authority of the Bureau of Land Management. The project site location is shown in Figure 1. Specifications for the steam generators were issued in October 1980 with bids received in January 1981. The contract for the boilers was awarded May 5, 1982.

The first unit of IPP is scheduled to be placed into commercial operation in July 1986, with the three additional units scheduled at 12-month intervals, thereafter. A photo of a plant model is shown in Figure 2.

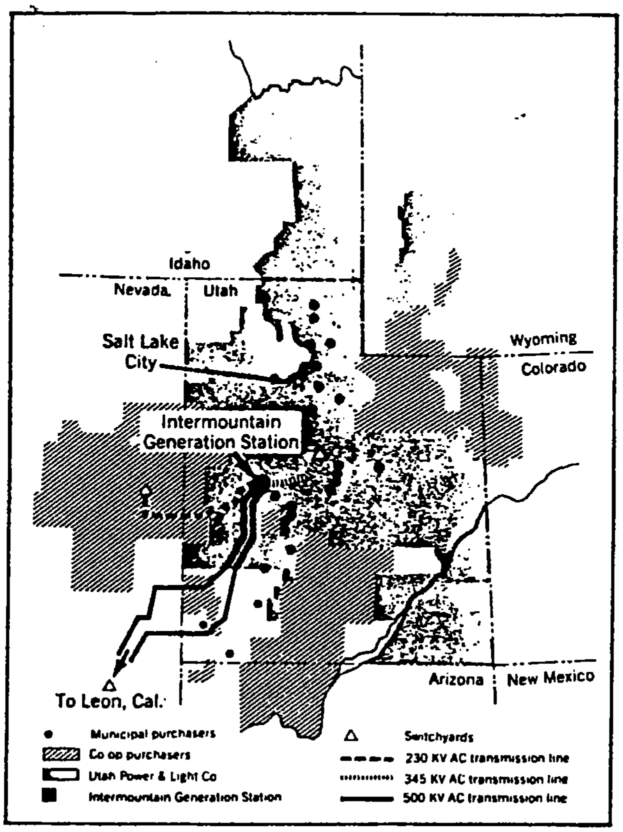

Figure 1 IPP site location.

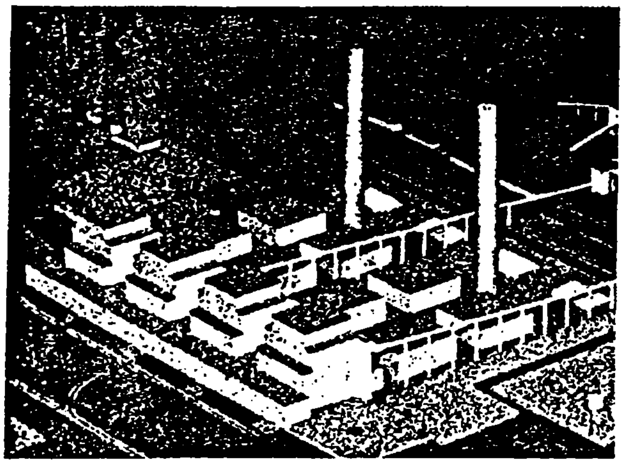

Figure 2 Plant model.

Boiler specifications and evaluation factors

In the process of preparing the specifications, the IPP project team made a concentrated effort to incorporate specific design features, and/or design criteria, that would improve boiler maintainability and availability so as to minimize the frequency and duration of forced outages.

An investigation of boiler component availability was made and Table 1 is representative of a high level component analysis. It ranks, in order, boiler components and their associated industry failure rates.

In order to address these areas of boiler forced outages and load reductions, the project adopted a very conservative design approach. For numerous components, conservative design parameters and material selections were specified. Also, features for improved access and maintainability were incorporated. The following discussion highlights some of these features.

Constant and variable pressure operation: Many utilities are now requiring that new boilers be designed for variable pressure operation. Variable pressure operation permits faster start-up and better matching of turbine metal/steam temperatures than constant pressure boilers. Variable pressure boilers are also designed to accept more thermal cycles because of the anticipated increased number of start-ups, shutdowns, or load ramping.

Furnace plan heat release rate: An investigation was conducted of the furnace plan heat release (FPHR) rate as a function of boiler availability and coal characteristics. It was determined that the maximum FPHR rate for optimum availability at reasonable cost and operating flexibility was a

Table 1 Major causes of boiler outages

	All fossil units - full outage losses and estimated partial outage losses (%)
Boiler tubes	5.8
Fuel handling equipment	1.9
Continuous deratings	1.5
Fans	1.1
Slag, ash & fouling	1.1
Air preheaters	0.7
Emission controls	0.7
Burners	0.2
Other	2.3

EPRI NP-1191 Sept. 1979

value of 1.6 million BTU/ft^2 hr measured on a fuel input basis as defined by:

$$\text{FPHR} = \frac{\text{Input in Fuel Btu/hr}}{\text{Furnace Plan Area - Ft}^2}$$

Top burners to furnace platens: As part of the studies into furnace design, considerable thought was given to the distance between the top row of burners and the bottom of the furnace platens. Although this is somewhat dependent on steam temperature-control method and firing system employed, conservative design dictates the avoidance of high platen inlet gas temperatures and raises the platens; yet, first cost and operating characteristics bring the platens down. With due consideration of fuel characteristics, 80 feet was selected as the minimum for this project.

Convection tube spacing: Side-to-side clear tube spacing of 3 inches was specified to minimize backend pluggage. Tube banks were also arranged in-line, rather than staggered, to assure that deposits removed by sootblowers would fall to the economizer hoppers.

Gas velocity: Surveys indicated that many coal-fired units suffered from gas side erosion. The potential effects of erosion were minimized by specifying a maximum gas velocity of 55 feet per second.

Gas temperature: The gas temperature entering the close-spaced platen or pendant surfaces shall not be greater than 1900 F HVT at maximum continuous rating (MCR).

Metal selection: Metal selection criteria for pressure and non-pressure parts was reviewed for optimum availability.

The following major tube metal selection criteria were specified:

ASME specification	Maximum external metal temperature, °F
SA-213 Grade T2	950
SA-213 Grade T11	1,000
SA-213 Grade T21	1,075
SA-213 Grade T22	1,075
SA-213 Grade T9	1,150
SA-213 Grade T321H	1,400
SA-213 Grade T347H	1,400

The use of carbon steel was limited to 775°F at pressures greater than 50 psig, and a maximum of 825°F at pressures below 50 psig.

The use of SA209 Grade T1a material was prohibited altogether.

Bare economizer tubes: Finned economizers have been a source of ash pluggage and resulted in difficult maintenance for many utilities. Therefore, the economizer design was specified as bare tubes. As with other convection surfaces, the specifications also required that the economizer tubes be in line to minimize plugging and erosion.

Duct gas velocities: To avoid excessive pressure drop and duct vibrations, duct gas velocities were restricted to 50 feet per second.

Spare pulverizer capacity: Poor coal quality and pulverizer performance are major contributors to unit deratings. To compensate for these facts, the specifications required that the boiler be furnished with adequate pulverizers to attain full load, having one spare pulverizer and all others in a worn condition, based on a specified coal with poorer overall quality than the design coal. This is a very significant design criteria which should result in greater boiler availability and fuel flexibility.

Coal-air velocity: To reduce the maintenance of coal-air piping due to erosion, the coal-air velocity was restricted to a maximum of 85 feet per second.

Ceramic coal pipe lining: The primary point of erosion wear in coal-air piping is at any elbow and immediately above the pulverizers. To minimize the wear in these areas, ceramic lining was specified.

Stainless steel downspouts: To prevent coal hang-ups between the feeders and the pulverizers, 304 stainless steel downspouts were specified.

P.A. fan capacity: In order to compensate for possible poor fuel quality in the future and additional possible air preheater pressure drop, test block margins of 25 percent on flow and 50 percent on pressure were specified. Each fan was also specified to be capable of providing sufficient primary air to permit boiler operation at 60% of maximum capacity with each of the specified coals.

Access doors and view ports: Once a tube failure occurs, quick access and repair is essential to minimize the forced outage. Therefore, numerous access doors were added in the boiler furnace, penthouse and backpass. Access doors, large enough to accommodate scaffolding, will be installed near the top of the furnace, in the backpass, and in the penthouse. Smaller access doors were also added in the hopper throat and backpass walls. Numerous view ports are required for monitoring burners and platens.

Maintenance space: To facilitate quick repair and access for maintenance, the specifications required sufficient cavities between horizontal banks of tubes for a welder to gain access and work under reasonable conditions.

Burner shutoff valves: To facilitate coal-air piping or burner maintenance while the boiler is on the line, shutoff valves at each burner were specified.

Additional air heater capacity: In addition to the specification of redundant gas/air streams for air heating to allow for air heater degradation and fuel flexibility, the regenerative air heaters were required to be designed for the future addition of 8 inches of heat transfer elements.

Reheat surface adjustment: Since the reheater may occasionally prove to be under-surfaced due to design uncertainties or coal deviation, space was provided to add reheater surface, should this prove necessary, after initial unit operation or in the future.

Table 2 categorizes those features specified for improved availability. The features listed are major design parameters, special provisions for maintainability, and provisions to minimize forced outages.

During the proposal review period, a rigorous economic and comprehensive technical evaluation was made.

The technical evaluation centered around ascertaining each bidder's potential for high availability as related to his design features, design conservatism and in relationship to numerous reference units which are in operation. A technical decision matrix was generated which listed key technical considerations and their relative weighting (see Table 3). Each proposal was then given a relative score for each category, with the best proposal in each category receiving a score of ten. This matrix proved very beneficial in summarizing each proposal's design features and presenting such information to management.

The final phase of the evaluation consisted of an availability evaluation. A consultant with expertise in statistical analyses and familiar with the utility industry was retained for this purpose. Using North American Electric Reliability Council

Table 2 Features for improved availability

Major design parameters	Special provisions for maintainability
Plan area heat release of 1.6×10^6 Btu/ft²/hr.	Cera-VAM® ceramic coal pipe lining.
Maximum gas velocity - 55 fps.	Access doors and view ports.
Furnace exit gas temperature - 2115F HVT.	Large access space between tube banks.
Burner zone heat release rate.	Shutoff valves at coal burners.
Volume liberation.	Provision for RH surface adjustment.
80 ft. minimum distance top burner to platen.	
Maximum coal air velocity 85 fps.	

Features to minimize forced outages

- Boiler designed for fast start-up, variable pressure operation.
- Lower tube metal temperature limits.
- Bare tube economizer.
- Two spare pulverizers.
- 304 stainless steel coal downspouts.
- Extra primary air fan capacity.
- Minimum RH tube thickness .180".
- All seamless boiler tubing.
- High waterwall tube mass velocity.
- Minimum convection tube clear side, spacing - 3".
- Air heaters designed for future surface additions.
- Ribbed tubes in furnace area.

Table 3 Technical decision matrix Intermountain Power project boilers

	Weighting factor
Western coal experience	11
2400 psi - 750 MW experience	10
Tube design conservatism	9
Low NO_X potential	9
No radiant reheater	7
Low slagging potential	7
Low fouling potential	7
Furnace access	4
Backpass access	4
Pulverizer capacity	7
Sootblower maintenance	3
Boiler response rate	4
Same burner experience	4
Burner zone heat input	4
Same pulverizer experience	6
Ribbed tube experience	4
Weighted total	10
Simple total	160

(NERC) data and also information furnished by each bidder in their proposals, a probabilistic analysis of availability was made. These results were combined with a value for replacement energy to ascertain a value for any projected differences in availability.

The final selection of the successful bidder was based upon consideration of all three evaluations — economic, technical and availability. In recognition of each of the bidders, each proposal was very well thought out and represented a very good design. The proposal selected as the best offering for IPP was that made by the Babcock and Wilcox Company.

Boiler description

Each of the four natural circulation, balanced draft, single reheat boilers (Figure 3) are designed for a nominal rating of 6,100,000 lbs/hr of steam at a superheater outlet pressure of 2515 psig and superheater and reheater outlet temperatures of 1005 F. The maximum continuous design steam flow (MCF) is 6,600,000 lbs/hr at a superheater outlet pressure of 2640 psi with superheat and reheat outlet temperatures of 1005 F. (Additional boiler performance data is shown in Table 4). The radiant boilers are of the Carolina design (RBC) with steam temperature control by gas biasing and spray attemperation. Each steam generator supplies a General Electric turbine generator having a nominal rating of 820 MW. The net unit output is 750 MW. Each unit will be totally enclosed.

The furnace is of the dry bottom type and is 85' wide, 60' deep. The top of the top support steel is 288 ' above grade.

The design pressures for the furnace and superheater, reheater, and economizer are 2975 psi, 750 psi, and 3050 psi, respectively.

Each unit is equipped with eight MPS-89 pulverizers (Figure 4) arranged with four mills along each side. Each pulverizer supplies a single horizontal row of dual register burners. There are four burner rows in each of the front and rear walls. The unit is capable of operating at MCR on performance coal with two mills out of service.

Additional equipment to be supplied by The Babcock & Wilcox Company (B&W) includes coal feeders with nuclear flow detectors, two primary and two secondary regenerative air heaters, two centrifugal primary air fans and motors, steam sootblowers and the burner management system.

A wet gas scrubber for SO_2 removal and a baghouse for particulate removal, furnished by others, will be located downstream of the air heaters.

The steam drum is 72" I.D. and equipped with cyclone steam separators arranged in four rows (Figure 5). Water from the drum is conveyed to the bottom of the unit via five downcomers from which the flow is then distributed to the lower furnace enclosure wall headers, utilizing multiple connections.

The furnace enclosure is made up of membraned multi-lead ribbed tubes (Figure 6). The unit is designed for a minimum average tube mass velocity of 800,000 lb/ft²/hr which results in a circulation ratio of 3.2

Dry saturated steam from the drum passes, in parallel, through the furnace roof, pendant convection pass and horizontal convection pass sidewalls; after which, it is distributed to the horizontal convection pass front and rear walls as well as the baffle wall which separates the two downflow gas passes at the rear of the unit. The front gas pass contains horizontal reheat surface and the rear gas pass contains the horizontal primary superheater and economizer surface. A schematic of these flow paths is shown on Figure 7.

From the horizontal enclosure wall, steam is fed to the primary superheater inlet bank; then successively to the pendant primary surface, located at the top of the furnace, the platen secondary superheater inlet surface and finally the platen secondary superheater outlet surface. The secondary superheater outlet surface discharges alternately to two outlet headers, with each header having one outlet connection. Discharging alternately to the two outlet headers minimizes the potential for steam temperature unbalance in the two outlet steam connections due to any side

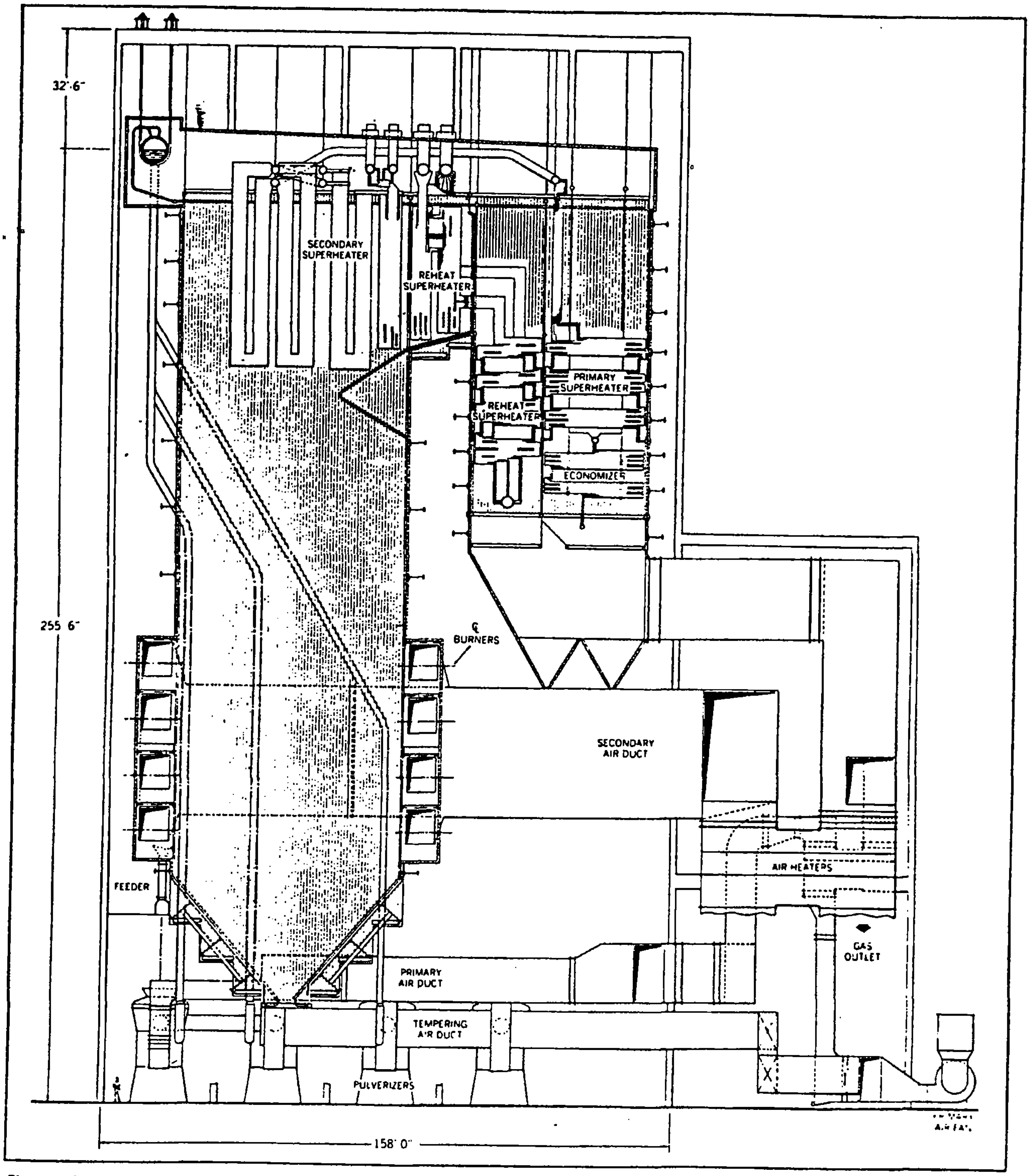

Figure 3 Sectional side view.

unbalanced gas temperature or gas flow. A schematic of this arrangement and side-to-side tube spacing is shown in Figure 8.

Pendant surface alignment is maintained using split ring castings, as shown in Figure 9. These castings eliminate the use of "wrap around tubes" which in the past have been a source of tube erosion and premature tube failures.

Table 4 Boiler performance data

	100% load	MCR
Steam leaving the superheater, lb/hr	6,100,000	6,600,000
Steam leaving the reheater, lb/hr	5,000,000	5,500,000
Excess air leaving the economizer, %	17	17
Fuel input 10^6 Btu/hr	7932	8040
Coal flow, lb/hr	720,400	730,200
Steam pressure at superheater outlet, psig	2515	2640
Steam pressure at reheater outlet, psig	511	562
Steam temperature leaving superheater, F	1005	1005
Steam temperature leaving reheater, F	1005	1005
Flue gas temperature leaving air heater, F	280	280
Water temperature entering economizer, F	543	555
Boiler efficiency, %	88.57	88.45

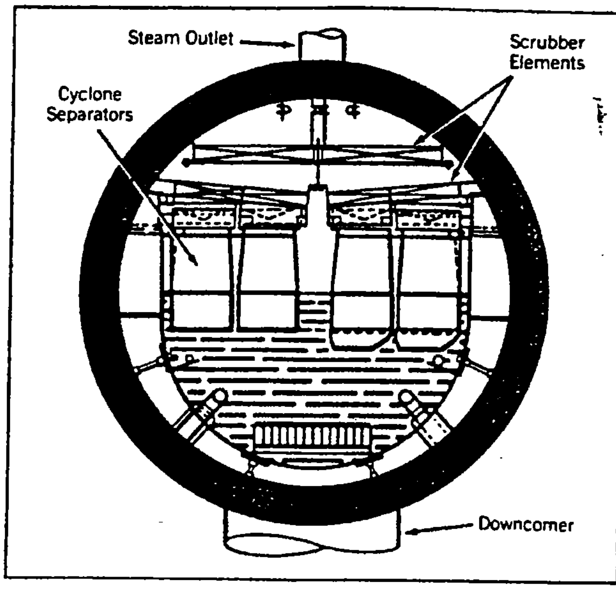

Figure 5 72-inch ID drum.

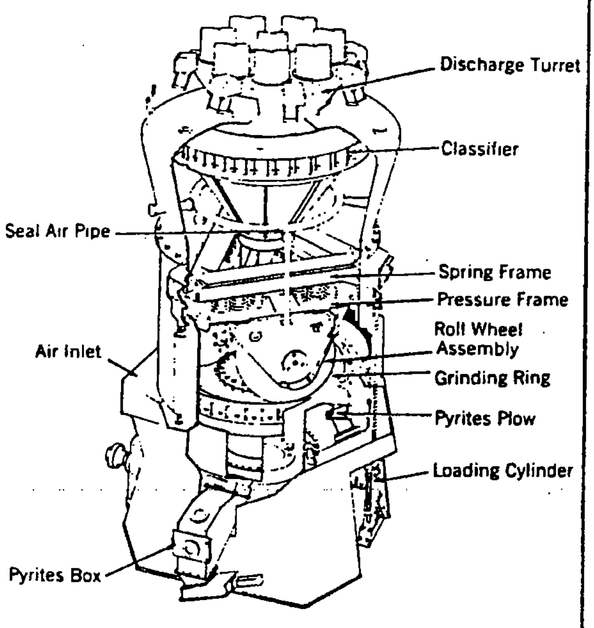

Figure 4 MPS pulverizer.

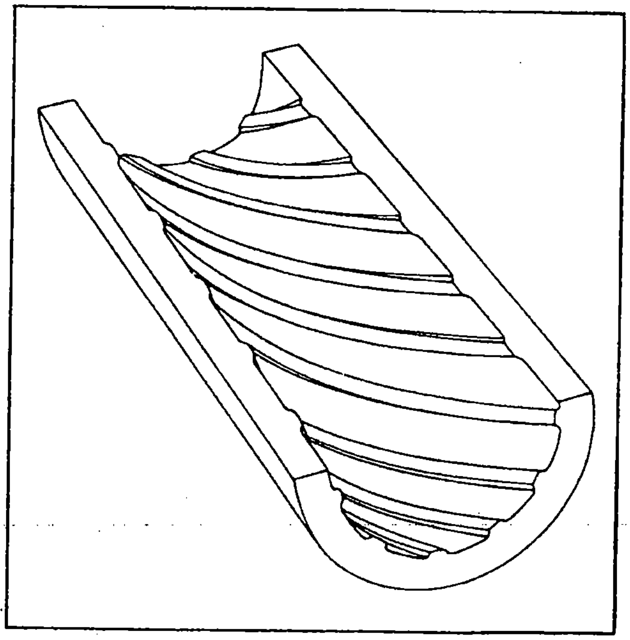
Figure 6 Ribbed tubes.

Spray attemperators for final steam temperature control are located in each of the two cross-over connections between the rear horizontal and pendant primary surface. Spray attemperators are also located in each of two cross-over connections between the pendant primary outlet surface and secondary superheater inlet surface.

All spray attemperators are equipped with two full-size attemperator stations in parallel. Each valve station consists of individual control and block valves.

Cold reheat steam enters the lower reheat inlet header, located at the bottom of the front gas pass, through both ends of the header. Steam then flows upward through the horizontal surface to the pendant reheat surface which also discharges to two reheat outlet headers, each having one outlet nozzle. There are spray

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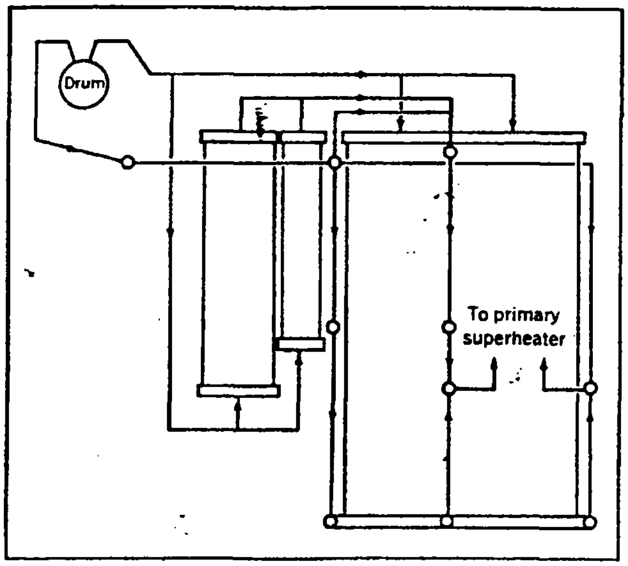

Figure 7 Schematic of convection pass enclosure walls.

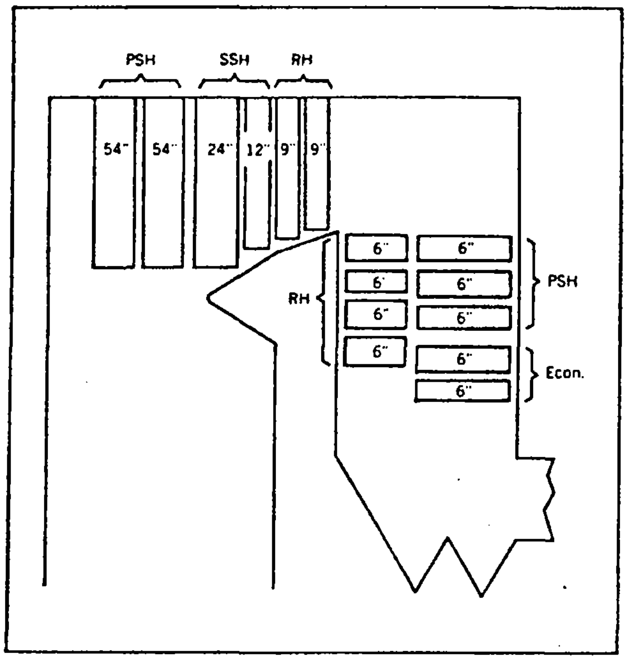

Figure 8 Schematic of convection surface arrangement and tube spacing.

attemperators located in the cold reheat inlet piping for controlling reheat steam temperature under upset conditions, if required.

Reheat steam temperature is controlled down to 65% load by use of biasing dampers, located in the bottom of the downpass, to bias gas flow across the reheater.

The unit is equipped with a compartmented windbox, Figure 10, with each compartment supplying air for a single horizontal row of

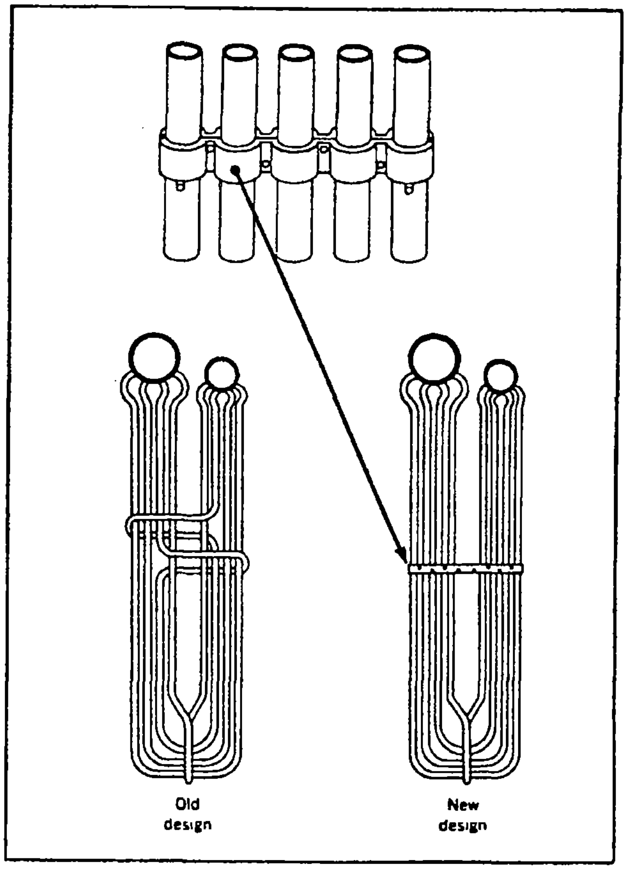

Figure 9 Split ring castings.

burners. Air is admitted from both ends. As a result, air can be controlled on a per compartment basis with all burners within a compartment receiving coal from a single pulverizer.

Coal piping from the pulverizers to the burners are lined with wear resistant Cera-VAM® ceramic material at all elbows to minimize burner line erosion. The vertical discharge coal pipe immediately above each pulverizer is also lined with Cera-VAM® .

Each burner line is equipped with a swing valve at the pulverizer outlet and also at the burner. This will permit isolation of individual burner lines for maintenance purposes, if it should become necessary.

Each of the units is equipped with a partial superheater bypass system to enable better matching of boiler and turbine temperature and to provide a means for positive control of steam conditions during start-up and shutdown. The bypass system, Figure 11, consists of a reheat outlet header attemperator, utilizing high pressure saturated steam as the attemperating medium and a high pressure bypass connection to the condenser. It offers faster cold or hot start-ups,

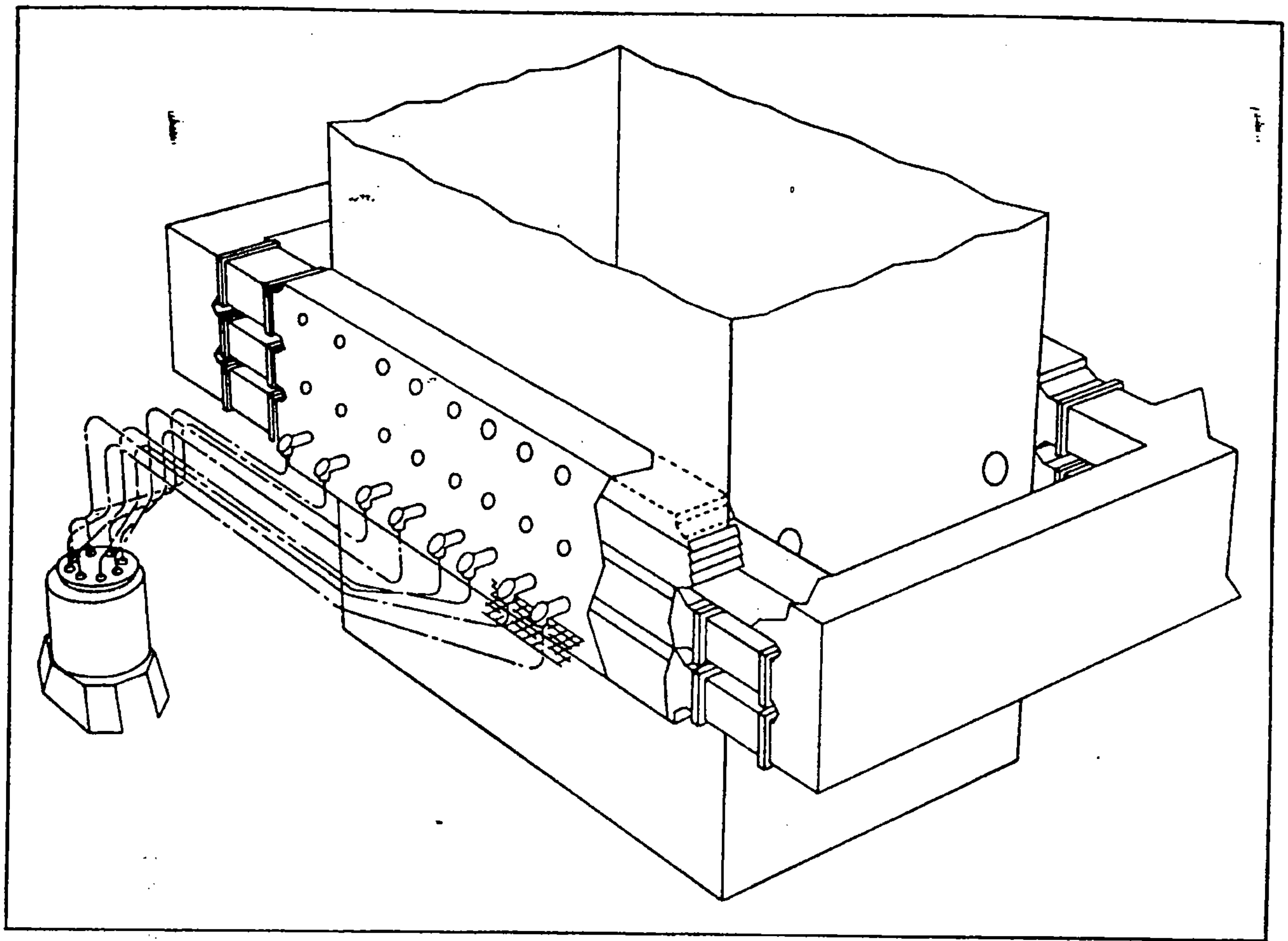

Figure 10 Compartmented windbox.

controlled shutdowns, and minimization of thermal stress on the turbine due to thermal unbalance during start-up and over-the-load range. Specifically, it performs two functions:

- Control of drum pressure by means of a superheater bypass to the condenser.
- Control of reheat outlet steam temperature by means of an attemperator utilizing saturated steam from the drum.

The unit is also arranged for the possible future installation of a full bypass system, Figure 12, which would include isolating valves between the primary and secondary superheater and secondary superheater outlet header attemperator.

Application of the full bypass system would provide the following additional functions:

1. Superheater outlet pressure control with a superheater stop valve and a superheater stop bypass valve. The pressure level at the inlet to the turbine control valves is then independent of the drum pressure over most of the load range.
2. Main steam temperature control during start-up and at low loads, with a superheater outlet steam attemperator and a superheater stop valve and stop valve bypass between the primary and secondary superheater.

The units are designed to fire a range of Utah bituminous coals. Analysis for the performance coal is provided in Table 5. The performance coal is rated as high slagging and high fouling. However, some of the alternate fuels are classified as severe fouling and severe slagging, and this has been taken into consideration in the boiler design.

Each of the dual register burners, Figure 13, is equipped with remote operated air-atomized lighters using No. 2 oil. In addition, each lower row of burners in both the front and rear wall is being equipped with a plasma torch direct coal-ignition system as shown in Figure 14. The use of the plasma torch as a direct ignition source for the coal will enable start-up and stabilization of the fires with minimal use of No. 2 fuel oil.

A complete array of Diamond Power steam sootblowers is being furnished for ash removal

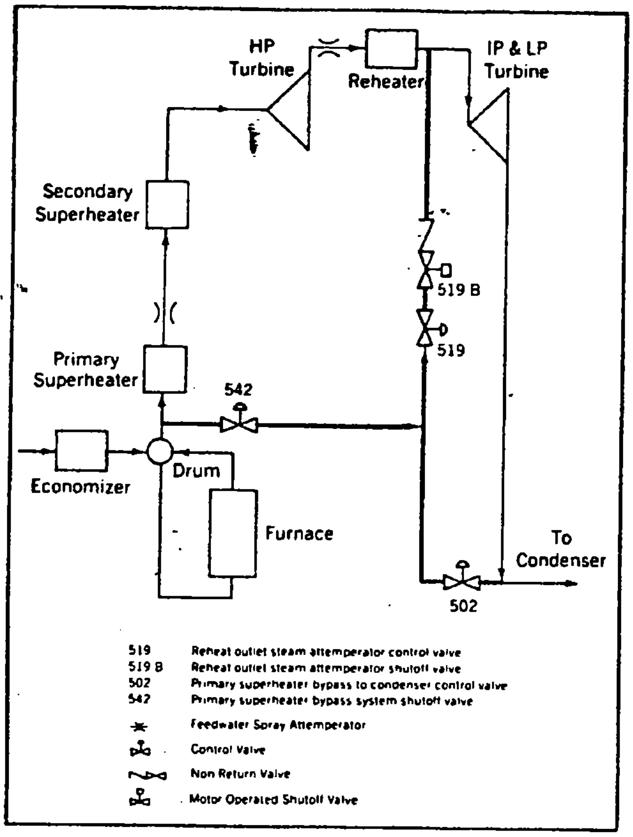

Figure 11 Partial bypass system.

from both the furnace walls and convection surfaces (see Figure 15).

The initial complement of blowers will include 54 wall blowers, 52 long retractable sootblowers and 16 half-track sootblowers. Wall boxes will also be installed initially for 75 future wall blowers, 40 future long retractable sootblowers and 12 future half-track sootblowers. These wall boxes could be used for either additional sootblowers or a rearrangement of the initial sootblowers, depending upon the exact fuel being burned and its slagging/fouling characteristics.

Sootblowers are also being furnished for the four air heaters.

Steam source for furnace and convection pass sootblowers will be from an intermediate superheater header. The steam source for the air heater sootblowers will be from the secondary superheater outlet header.

Comparison to other large coal-fired boilers

The industry accepts major gas side and water/steam side design parameters as indication of the conservatism of a particular boiler design.

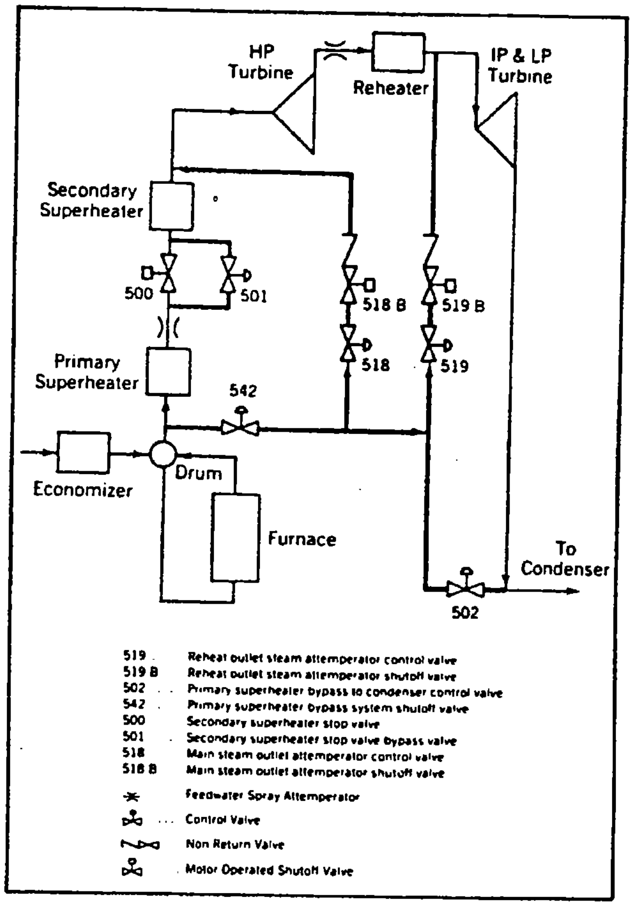

Figure 12 Full bypass system.

It is useful to review these parameters in relationship to the manufacturer's experience.

Water side design: In order to provide an adequate margin of safety for cooling of the furnace wall tubes, the maintenance of a conservatively high minimum departure from nucleate boiling ratio (DNBR) was set as a primary design objective by B&W. DNB ratio is defined as follows:

$$\text{DNBR} = \frac{\text{Minimum heat flux required for DNB (Btu/ft}^2\text{/hr)}}{\text{Maximum upset heat flux (Btu/ft}^2\text{/hr)}}$$

A minimum DNBR of 2 was established as the design objective. As a comparison, a nuclear reactor has a DNBR of 1.2. The minimum DNBR for B&W furnace tubes occurs just above the top row of burners at the point of maximum upset heat flux. Therefore, at the steam qualities being encountered along the length of the furnace tubes, the predicted maximum upset heat flux (caused by

Table 5 Utah coal and ash analysis

	Performance coal	Range
Proximate analysis		
Moisture	8.3	7.4 - 9.4
Volatile matter %	37.1	35.0 - 40.0
Fixed carbon %	40.6	38.0 - 44.0
Ash %	14.0	8.0 - 16.0
Higher heating value, Btu/lb	11,010	10,500 - 12,100
Grindability	48	43 - 53
Ash analysis %		
SiO_2	58.8	49.3 - 61.0
Al_2O_3	13.5	10.7 - 16.8
Fe_2O_3	5.9	3.9 - 7.9
TiO_2	0.7	0.5 - 0.9
CaO	9.3	3.9 - 14.6
MgO	2.0	0.8 - 3.0
Na_2O	1.6	0.6 - 3.0
K_2O	0.9	0.6 - 1.3
SO_3	5.9	2.9 - 8.9
P_2O_5	0.3	0.1 - 1.0
Undetermined	1.1	0.3 - 0.3
Ash fusion temperatures		
Reducing: Initial deformation	2180	2075 - 2300
Softening	2215	2095 - 2340
Hemispherical	2245	2115 - 2380
Fluid	2330	2190 - 2470
Oxidizing: Initial deformation	2240	2130 - 2355
Softening	2300	2135 - 2455
Hemispherical	2325	2200 - 2450
Fluid	2410	2255 - 2570

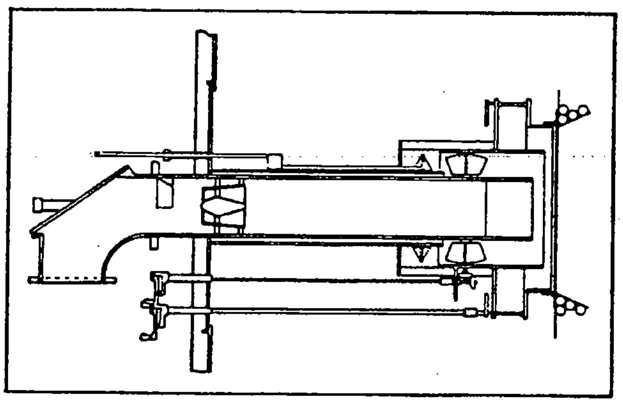

Figure 13 Dual register burner.

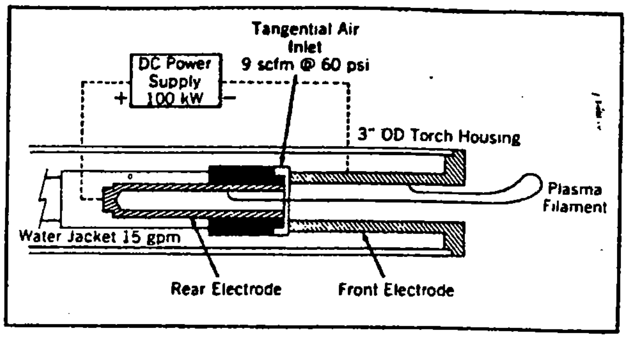

Figure 14 Plasma torch ignitor.

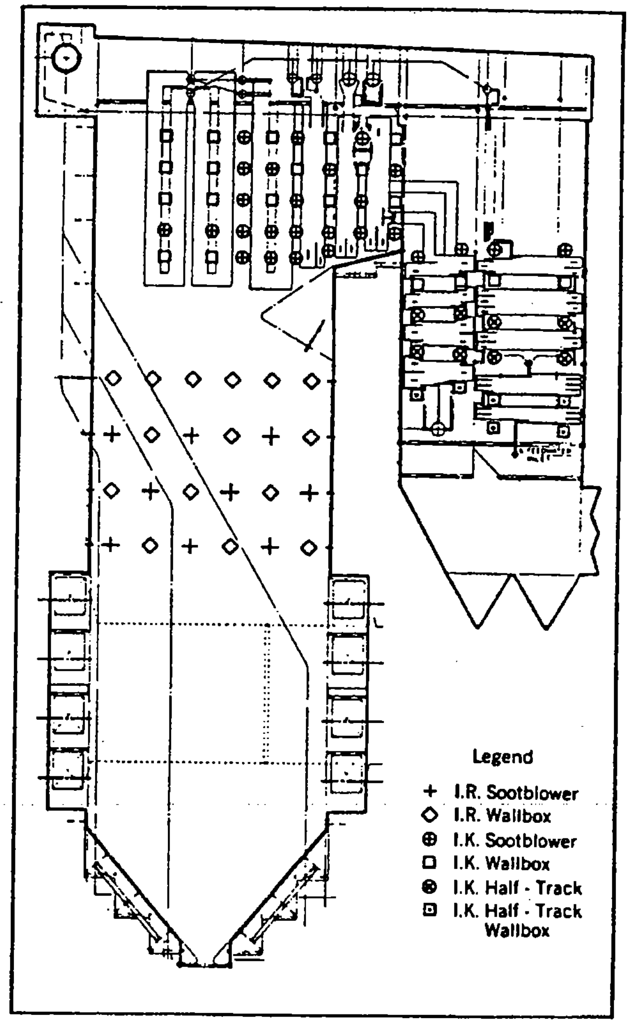

Figure 15 Sootblower installations.

overfiring or other local conditions) would not be greater than ½ the heat flux required to cause DNB. A typical DNB curve is shown on Figure 16. As can be seen from the cure, the minimum DNBR for smooth tubes designed for a mass flow of 800,000 lbs/ft²/hr occurs just above the top burner level at point B where the DNBR approaches 1. By contrast, the minimum DNBR for the IPP design with ribbed tubes at this same mass flow and same elevation in the furnace is greater than 2. This design philosophy, used in many units, has resulted in reliable furnace circuitry. The average minimum mass velocity for recent B&W designs is between 800,000 and 900,000 lbs/ft²/hr. Although B&W units have been tested for minimum circulation mass flows below 600,000 lbs/ft²/hr and for circulation ratios below 2.5 for extended periods, excellent historical experience is available for circulation ratios of 3 and above, with minimum average tube mass velocities of approximately 800,000 lbs/ft²/hr.

Gas side design: As mentioned previously, the major specified design parameters included are:

1. Heat release per square foot of furnace plan area of 1.6 million Btu/ft²/hr.

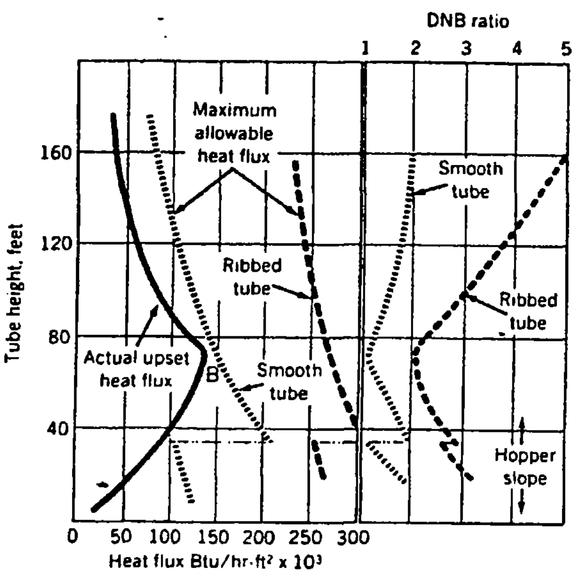

Figure 16 DNB curve.

2. Gas side design maximum velocity of 55 fps.
3. Gas temperature entering close-spaced pendant surface must be less than 1900 F HVT.
4. Minimum distance from top burner to platen of 80 feet.

Each of these criteria are conservative relative to B&W's experience. A listing of operating B&W units (Table 6), having large open furnace of the size employed for this project, includes sixteen units with average plan area heat release rate of 1,875,000 Btu/ft²/hr, gas side maximum gas velocity of 65 fps and FEGT of 2195 F HVT. Average unit size is 975 MW.

These large boilers have performed very well, turning in a cumulative boiler availability of over 90% for 97 unit years of operation. This is well in excess of the industry average of 84.7%, as reported by the operating utilities to the North American Electric Reliability Council (NERC). The IPP boiler design represents a more conservative application of these design criteria than those large boilers which were designed in the early '70s.

Figures 17 through 20 show the relative position of the IPP units compared to other recent B&W contracts for these various gas side design parameters of burner zone release rate, heat input to furnace plan, gas velocity and gas temperature entering the pendant superheater. It can be seen that the IPP units rank with the most conservative B&W units designed for bituminous coals. This conservative approach was a decision which the Intermountain Project expects will provide benefits in improved equipment reliability.

Availability improvement program

The customer, his A/E (Black & Veatch) and the Babcock & Wilcox Company have agreed to mutually support and participate in an Availability Improvement Program (AIP) in

Table 6 Operating large open-furnace boilers

		Plan area (ft²)	Plan area heat release Btu/ft²-hr × 10³	FEGT/ spacing	Maximum gas velocity fps
Detroit Edison	Monroe 1-4	3645	1929	2250/18"	71
Ohio Power	Amos 3	5661	2108	2225/18"	64.7
Duke Power	Belews Creek 1-2	4590	2126	2180/18"	75
AEP	Gavins 1-2	5661	2108	2225/18"	64.7
	Mountaineer 1	5661	2215	2220/18"	68.6
Texas Utilities	Monticello 3	5130	1538	2000/24"	58.6
Kansas City P&L	La Cygne 2	4182	1554	2130/24"	59
	Iatan 1				
Iowa P&L	Council Bluffs	3927	1775	2190/18"	57
Houston L&P	Parish 5-6	4182	1554	2220/24"	59

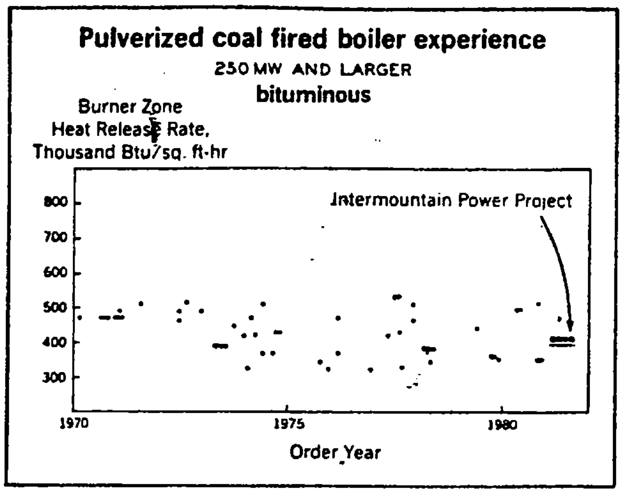

Figure 17 Burners zone release rate experience.

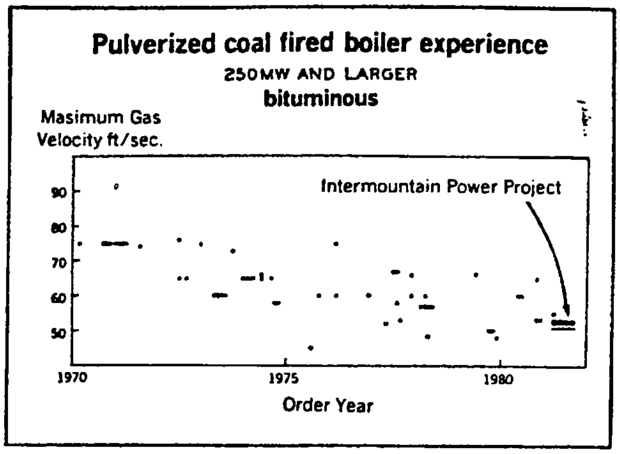

Figure 19 Gas side velocity experience.

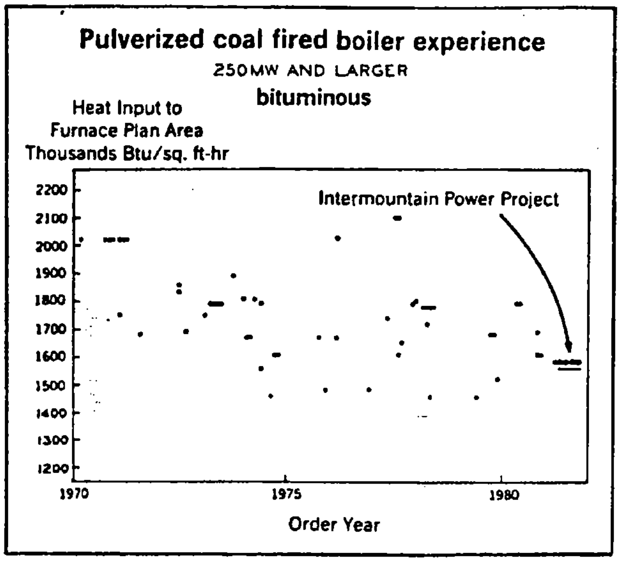

Figure 18 Heat release per square foot of furnace plan area experience.

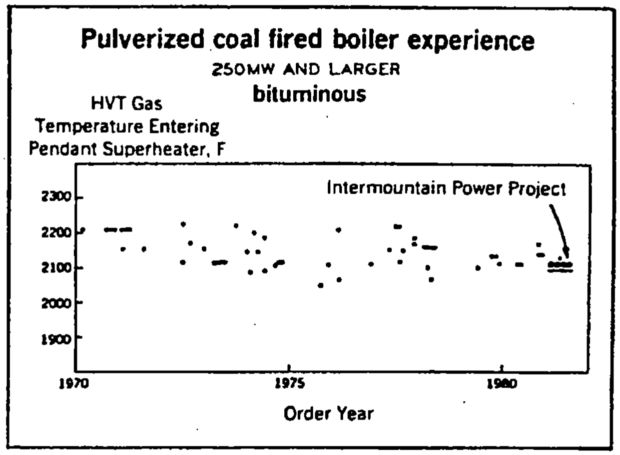

Figure 20 Gas temperature leaving the furnace experience.

further efforts to achieve high availability.

The purpose of the AIP is to ensure that the IPP boilers and interfacing plant equipment are designed, manufactured, erected and operated to achieve maximum operating availability. This purpose will be achieved through a formal structured task force committee.

Aside from monitoring the progress and performance of the IPP units, there are 17 pre-selected Babcock & Wilcox Co. units, installed at ten different locations, having certain similarities to the IPP units which will be monitored to determine root causes of unit outages or reduced capability. A determination would then be made as to whether or not the IPP units would be subject to the same problems and, if so, what can be done to prevent them on the IPP units.

The reviews will go beyond the terminals of the boiler scope to include all interfacing plant equipment such as feedwater systems, fuel preparation, ash handling, controls, etc.

The goals of the IPP will be implemented through an availability task force. The task force will meet periodically to review the operating history of the reference plants; review items that have arisen on the IPP units; and to make recommendations for the improvement of availability in the areas of design, fabrication construction and operation. The composition of this organization and its membership is shown on Figure 21:

Similar programs are being established by IPP with other major plant equipment suppliers.

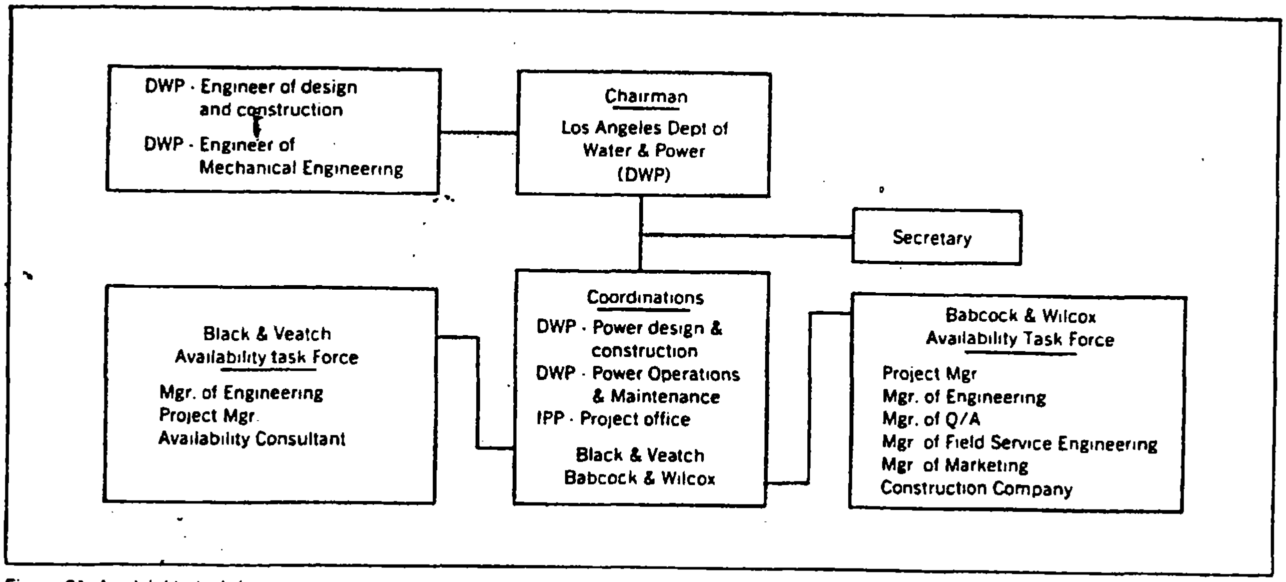

Figure 21 Availability task force.

Conclusion

This paper has addressed major criteria that were specified for the steam generators and an evaluation of design conducted by the Intermountain Power Project and how these factors were treated in the design of the boiler units by the Babcock & Wilcox Company. We have also reviewed the concept of an availability improvement program geared to further improve the design, manufacturing and erection of these units. The Project is confident that these steps will achieve the desired goals and we look forward to reporting the support of this project after these units are placed into operation.